

REMARKS

Independent claims 41-43 have been amended to improve grammar and clarify the claimed invention. Claims 4-12, 18-23, 25 and 41-43 are now pending.

On page 2 of the office action, claims 4, 6, 8, 10-12, 18-23, 25 and 41-43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bass *et al.* (US 6,789,764) in view of Vertatschitsch *et al.* (US 5,294,075), Karem (US 2002/0022909), Hadley *et al.* (GB 2213931) and Churchill *et al.* (US 5,352,090). In support of this rejection, the Examiner further asserts it is old and well known in the art to control the rpms of rotors for various reasons. Applicant traverses this ground of rejection for the following reasons.

US Patent No. 6,789,764 to Bass

Bass describes the basic tandem-rotor layout, but discloses three distinct embodiments respectively depicted in Figures 1, 5 and 6.

The embodiment shown in Figure 1 has similarities to Applicant's aircraft wherein two rotors can be independently driven by exhaust gases that flow through respective independently operable valves. This embodiment is not provided with and does not require a system for avoiding interference or collision between the rotors because the vertical locations of

the rotors are sufficiently distant from each other "to avoid interference during vertical lift mode" (see Bass, col. 4, ll. 3-5). Thus the Examiner's statement on page 4 of the action that "Bass discloses a dual rotor aircraft (figure 1) wherein the rotors are NOT mechanically coupled together thus it would be possible for the blades to collide" is erroneous.

In addition to the same drive system as in the Figure 1 embodiment, the embodiment shown in Figure 5 of Bass has a synchronization shaft 90 which is coupled to the hub assemblies of both rotors "to prevent rotational interaction" between the rotors (see Bass, col. 5, ll. 63-65). As stated in col. 6 at lines 3-6 of Bass: "The synchronization shaft configuration potentially allows for increased flapping degrees of freedom blades 40', since overlapping is prevented"(emphasis added).

Lastly, the third embodiment shown in Figure 6 has a drive system that produces exhaust gases which drive one rotor, while the other rotor is driven by a drive shaft 92 that is mechanically coupled to the driven rotor. Since the rotors are mechanically coupled, interference or collision of the rotors is not possible in this third embodiment.

Thus, Bass teaches two embodiments (Figures 1 and 6) in which interference or collision of the rotors is not possible, so that a subsystem for preventing such rotor

interference or collision is not necessary. To the extent that the Examiner has taken the position that it would be obvious to incorporate the teachings of the secondary references into either the first or third embodiment disclosed of Bass in order to provide a subsystem for preventing rotor interference or collision, that position is clearly untenable since those embodiments of Bass have no need for such a system. Applicant respectfully submits that it would not be obvious to import a subsystem for preventing rotor interference or collision into the Bass aircraft since such subsystem would be superfluous.

Furthermore, in the second embodiment of Bass (Figure 5), the subsystem for preventing rotor interference or collision is a synchronization shaft. Since Bass teaches a solution to the problem of rotor interference/collision using a synchronization shaft, Applicants respectfully submit that it would not be obvious to take components from any of the four secondary references (namely, Vertatschitsch, Karem, Hadley and Churchill) in an attempt to design an alternative subsystem for preventing rotor interference or collision. Because Bass has already solved the problem, it would not be obvious to a person skilled in the art to import a new solution to the same problem.

The rotors in the Figure 5 embodiment of Bass inherently rely on cross-shafting in order to stay in phase, so

that their blades can never come into contact with one another. The instant patent application maintains safe rotor positions in an entirely different way, through active management of each rotor's rotational position separately rather than by locking them together mechanically. The elimination of the weight and complexity of Bass' cross-shafting solution was a major object of the present invention. This was accomplished by providing means for actively monitoring and controlling the positions of blades in each rotor, something that the Bass patent did not contemplate. While some of the secondary references (discussed below) may have disclosed means for detecting the rotational positions of rotors on an aircraft, none of those secondary references mentions or is concerned with solving the problem of rotor interference/collision, let along solving that problem in a manner that reduces aircraft weight in comparison to the aircraft with synchronization shaft taught by Bass.

Furthermore, neither Bass nor any of the secondary references discloses or suggests the programming of a controller:

to determine the relative rotational position of said first and second rotors as a function of said rotor signals, compare said relative rotational position of said first and second rotors with a specified angular tolerance, and adjust a rotational speed of said first rotor in response to said comparison showing that said relative rotational position of said first and second

rotors is outside said specified angular tolerance. as is presently recited in amended claims 41-43 (hereinafter "Applicant's Programmed Controller Claim Limitations"). The Examiner has undertaken a hindsight reconstruction of Applicant's invention, which reconstruction is improper and, in any event, defective in view of the absence of a teaching of Applicant's Programmed Controller Claim Limitations in any of the cited prior art. To the extent that the Examiner contends these missing features were common knowledge, Applicant traverses that contention and requests that specific prior art be cited to support that contention. In the absence of prior art showing Applicant's Programmed Controller Claim Limitations, a *prima facie* case for obviousness has not been made.

In support of the foregoing traversal of the obviousness rejection based on Bass, Vertatschitsch, Karem, Hadley and Churchill, Applicant will now discuss each secondary reference.

US Patent No. 5,294,075 to Vertatschitsch

Vertatschitsch describes a way of measuring positions of rotating machinery such as helicopter rotors using electro-optical sensors. This is basically similar to the "detector" part of the instant patent application. Vertatschitsch discloses no concern for the problem of rotor interference/collision and

contains no suggestion that its electro-optical sensors would be suitable for use in a subsystem for preventing rotor interference or collision. Nor does Vertatschitsch disclose or suggest Applicant's Programmed Controller Claim Limitations.

Contrary to the Examiner's assertion at the bottom of page 3 of the office action, Vertatschitsch at col. 6, lines 54-59, does not teach a controller that "determines the relative rotational position of said first and second rotors as a function of said rotor signals. The cited extract from Vertatschitsch does not even mention the "relative rotational position" of two rotors. At best, the Vertatschitsch controller receives information representing the absolute rotational positions of the two rotors, but there is no evidence that the controller processes that information in order to compare those absolute rotational positions and then determine a relative rotational. Vertatschitsch does not determine the relative rotational position of the rotors because Vertatschitsch did not contemplate any use for such information.

GB Patent No. 2213931 to Hadley

Hadley describes a way to sense rotor blade position. The main focus is on track and lag measurements, both of which are referenced to a nominal blade-defined coordinate system which is of no use to Applicant's claimed invention; the

Applicant's invention needs to measure the position of each blade in its own rotational circle, not the up/down or forward/backward position of the blade with reference to its own x-y-z axes. But Hadley does mention, with regard to on/off switching of the blade sensors, that "it is possible to limit the trigger radiation to a relatively small time period, namely the time for which the blade is known to be in the vicinity of at least one of the sensor fields." This implicitly keeps track of the rotational position of the blades. Hadley then mentions pulse coding so that individual blades would be positively identifiable. However, Hadley does not disclose or suggest that the combination of rotational position knowledge and identification of individual blades could be used to solve the problem of rotor interference/collision. Instead Hadley is directed toward solving the problem of minimizing overall vibration in a helicopter over a wide range of flight conditions (see Hadley, p. 1, l. 20 to p. 2, l. 2). Nor does Hadley disclose or suggest Applicant's Programmed Controller Claim Limitations.

US Patent Publ. No. 2002/0022909 to Karem

Karem describes details of a method of controlling "complex machines and moving vehicles" with a man-machine interface. Rotorcraft applications are mentioned including "an

automated throttle to control the RPM of the rotor at the desired level" which is a current capability of "more expensive rotorcraft [using] autopilots," not a feature of Karem's invention. RPM control of single-rotor helicopters may be automated as described by Karem, but nothing in Karem envisions the separate control of RPM for two rotors, or the controller functions required to achieve that, as recited in Applicant's Programmed Controller Claim Limitations. Nor does Karem manifest any concern about the problem of rotor interference/collision. Applicant does not claim to have invented control of the RPM of a rotor, but rather a controller that performs the functions recited in Applicant's Programmed Controller Claim Limitations.

US Patent No. 5,352,090 to Churchill

Claim 1 has two parts, one involving detectors and one involving a controller that utilizes the detector data. The Churchill patent also involves detectors and processors for the detector data. Almost anything could be reduced to those simple terms, but what matters is the type of information that is being gathered by the detector and what that data is then being used for. The Churchill patent's sensor is measuring things that let it calculate parameters relating to rotor blade "track and balance." If you look at a rotating helicopter rotor edge-on, each blade passes by along a certain line, and that line has to be within a

certain up-down tolerance band in order to prevent out-of-balance vibrations. "Track and balance" refers to the process of adjusting each blade to follow the right line as it rotates. The Churchill patent therefore deals with parameters that affect up/down and possibly dynamic weight balancing factors (the latter being like spin-balancing a new tire on a car, again to prevent vibration).

The Examiner asserts that Churchill teaches controlling rotor RPM during flight in order to control vibration of rotary wing aircraft (see p. 4 of action). However, Churchill does not manifest any concern about the problem of rotor interference/collision and does not teach controlling RPM in a manner that solves that problem. Applicant does not claim to have invented control of the RPM of a rotor, but rather a controller that performs the functions recited in Applicant's Programmed Controller Claim Limitations. Those limitations are nowhere disclosed in Churchill.

Conclusion

As demonstrated above, none of the five prior art references cited by the Examiner discloses a controller programmed to determine the relative rotational positions of two rotors of an aircraft, compare that relative rotational position to a specified angular tolerance, and then adjust the rotational speed of one rotor "in response to said comparison showing that

said relative rotational position of said first and second rotors is outside said specified angular tolerance." At the bottom of page 4 of the office action, the Examiner asserts that to program a controller in this way would have been obvious in view of Bass because Figure 1 of Bass shows an embodiment in which the rotors, being not mechanically coupled, could collide. Applicant respectfully disagrees with this characterization of Bass. Bass explicitly discloses that the embodiment of Figure 1 has rotors vertically distant so that interference is avoided. In other embodiments (see, e.g., Figure 5 of Bass) in which rotor interference or collision is possible, Bass teaches the solution of mechanically linking two rotors using a synchronization shaft. The Examiner's assertion that it would be obvious from Bass to use Applicant's claimed controller ignores Bass' express teaching of a different way to solve the rotor interference problem.

Lastly, Applicant traverses the statement on page 5 of the action that it was known in the prior art to adjust the rotational speed of rotors. Obviously, simply turning on the engine of a rotor aircraft has the effect of adjusting the rotational speed of aircraft rotors, so the Examiner's assertion is a *non sequitur*. The issue is not whether adjusting rotor RPM was known, but rather was it known to adjust the RPM of a rotor

in response to a determination that the relative rotational position of two rotors lies outside a specified angular tolerance. This latter technical feature is shown nowhere in the art cited by the Examiner.

In view of the foregoing, Applicant respectfully submits that none of the pending claims is obvious and the rejection based on Bass in view of Vertatschitsch, Karem, Hadley and Churchill should be withdrawn.

On page 6 of the action, claims 7 and 9 were rejected as being unpatentable over Bass in view of Vertatschitsch, Karem, Hadley and Churchill, and further in view of Engels et al. (US 5,205,710). Applicant traverses this ground of rejection for the same reasons, set forth above, why claim 42, on which claims 7 and 9 depend, is not obvious in view of Bass in view of Vertatschitsch, Karem, Hadley and Churchill, and for the further reason that Engels also fails to disclose a controller that determines the relative rotational positions of first and second rotors and then adjusts the rotational speed of at least the first rotor when the relative rotational positions of the first and second rotors are outside a specified angular tolerance.

On page 6 of the action, claim 5 was rejected as being unpatentable over Bass in view of Vertatschitsch, Karem, Hadley

and Churchill, and further in view of Frank. Applicant traverses this ground of rejection for the same reasons, set forth above, why claim 42, on which claim 5 depends, is not obvious in view of Bass in view of Vertatschitsch, Karem, Hadley and Churchill.

In view of the foregoing, Applicant submits that this application is now in condition for allowance. Reconsideration of the application and allowance of claims 4-12, 18-23, 25 and 41-43 are hereby requested.

Respectfully submitted,

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Date


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August 15, 2008

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